FEMI209 720000-18

FLOOD INSURANCE STUDY

COMPILED
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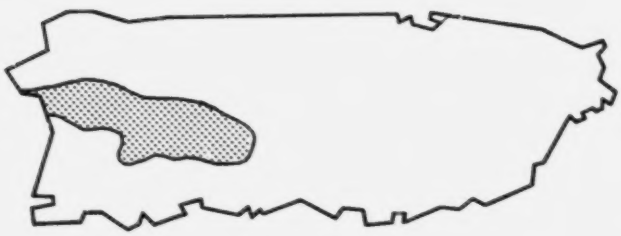
RIO GRANDE DE ANASCO BASIN, PUERTO RICO



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Rio Grande de Anasco — Panels 01P-13P

Exhibit 2 - Flood Boundary and Floodway Map Index
Flood Boundary and Floodway Map — Panels 0070, 0075, 0132, and 0135

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map — Panels 0070, 0075, and 0132

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study report has been prepared to revise and update a previous Flood Insurance Study for Rio Grande de Anasco Basin, Commonwealth of Puerto Rico, which was published on August 1, 1978. This information will be used by Rio Grande de Anasco Basin to update existing flood plain regulations as part of the regular program of flood insurance by the Federal Emergency Management Agency. The information will also be used by local and regional planners to further promote sound land use and flood plain development.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 24 CFR, 1910.1(d). In such cases, however, it shall be understood that the State (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgments

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were performed by the joint venture of POST, BUCKLEY, SCHUH & JERNIGAN, INC./LEBRON, SANFIORENZO & FUENTES, for the Federal Emergency Management Agency, under Contract No. H-4734. This work, which was completed in July 1980, covered all significant flooding sources affecting Rio Grande de Anasco Basin.

1.3 Coordination

Streams requiring detailed study and the limits of these studies were identified at a meeting attended by representatives of the study contractor, the Federal Emergency Management Agency, and community officials in March 1978. Results of the hydrologic analyses were coordinated with the Commonwealth of Puerto Rico Department of Natural Resources, the U.S. Geological Survey, and the U.S. Army Corps of Engineers.

The final coordination meeting for the Rio Grande de Anasco Basin was held on April 30, 1981, in the municipalities of Anasco and Mayaguez, and was attended by representatives of the study contractor, the Federal Emergency Management Agency, and community officials. There were no objections to this study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the Rio Grande de Anasco Basin, Puerto Rico. The area of study is shown on the Vicinity Map (Figure 1).

Flooding caused by overflow of Rio Grande de Anasco from the river mouth to approximately 400 meters upstream of Puerto Rico Highway 406 was studied in detail. This stretch is approximately 15.6 kilometers in length. Flooding on Rio Daguey from the intersection of Puerto Rico Highways 404 and 405 to approximately 1.9 kilometers upstream was studied by approximate methods, as the drainage area is less than 2.60 square kilometers.

Those areas studied by detailed methods were chosen with consideration given to all known flood hazard areas and areas of proposed construction and forecasted development through 1985.

2.2 Community Description

The Rio Grande de Anasco Basin is located in the west-central section of Puerto Rico, in the municipalities of Adjuntas, Anasco, Lares, Las Marias, Maricao, Mayaguez, and San Sebastian.

Rio Grande de Anasco Basin is bordered to the south by the Rio Tallaboa Subbasin, and Rio Yaguez, Rio Guanajibo, and Rio Yauco Basins. Upper Rio Grande de Arecibo Basin lies to the east, and the Lower Rio Grande de Arecibo, Rio Camuy, Rio Guajataca, and Rio Culebrinas Basins border it on the north. Rio Grande de Anasco Basin encompasses an area of 519.2 square kilometers, of which approximately 477.7 square kilometers are mountains and the remaining 41.5 square kilometers are flat areas. The flood plain comprises approximately three-fourths of the flatland.

Rio Grande de Anasco has its headwaters at an elevation of approximately 1204 meters and flows westerly 74 kilometers to the coast, where it discharges into the Bay of Anasco and Mona Passage. Rio Daguey is a tributary of Rio Grande de Anasco. It has a drainage area of approximately 15 square kilometers and a length of approximately 6 kilometers. Rio Daguey flows westerly to Rio Grande de Anasco, passing near the east side of the City of Anasco.

The land uses on the Rio Grande de Anasco watershed are distributed as follows: 278 square kilometers are used for cropland; 114 square kilometers are in pasture; 85 square kilometers are forest and woodland; 33 square kilometers are idle; and 13 square kilometers are in miscellaneous uses (including urban development) (Reference 1). The vegetation in the flood plain is primarily sugarcane. Soils in the flood plain are clay loams (Reference 2).

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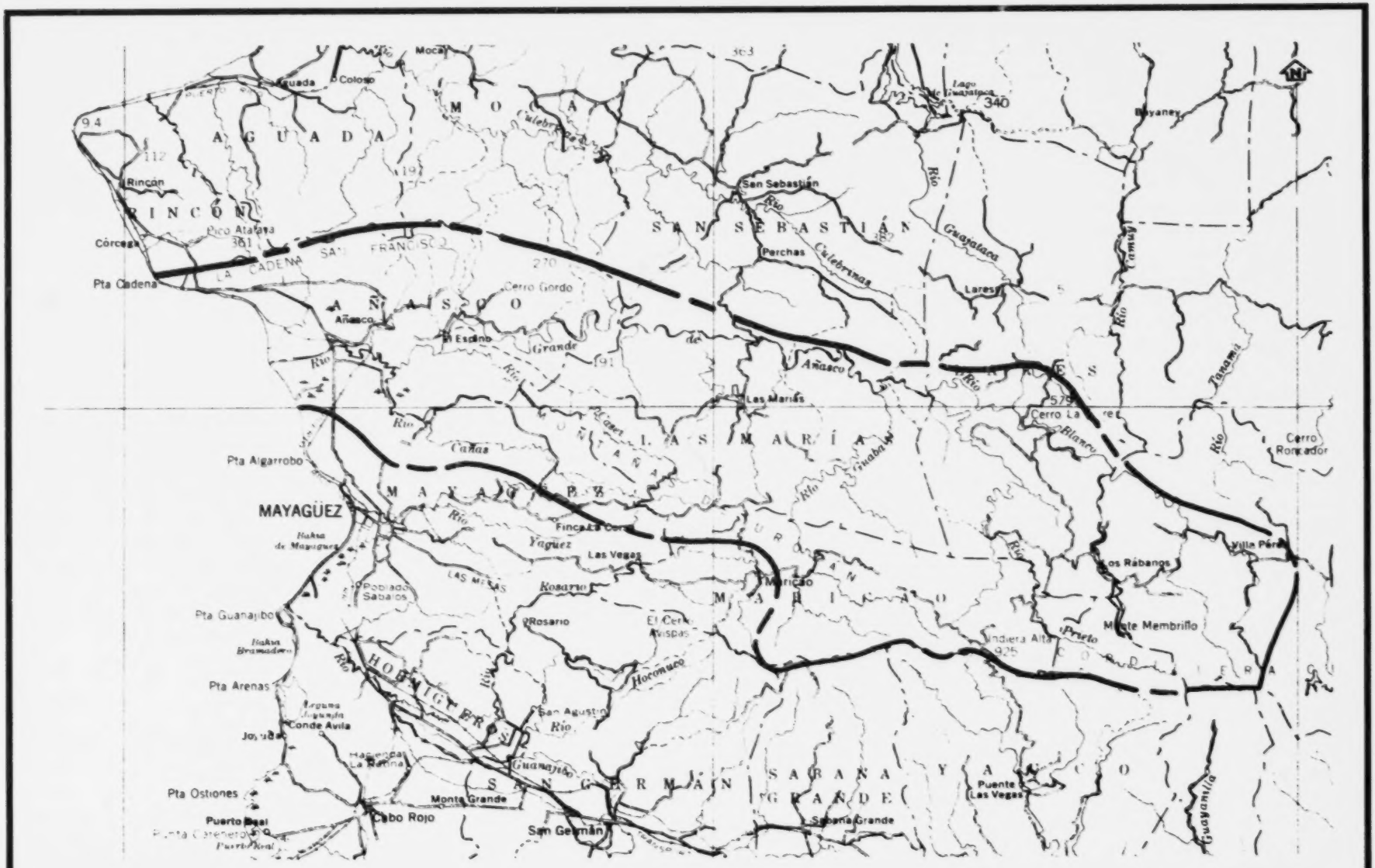

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE DE ANASCO BASIN, PR

APPROXIMATE SCALE

6 0 6 12 18 KILOMETERS

VICINITY MAP

The entire Rio Grande de Anasco watershed is in the humid mountainous physiographic area of Puerto Rico. The Atalaya Mountains extend from the coastline eastward along the north side of the flood plain, merging with dissected plateau remnants at slightly lower elevations, north of the City of Anasco. The Atalaya Mountains have a maximum elevation of approximately 300 meters. The Cordillera Central rises out of an elevated dissected highland area south of Maricao and extends eastward south of Adjuntas. The elevations of this main mountain range vary from 915 meters to almost 1220 meters.

The principal communities affected by floods within the study area are the residential developments of the Anasco Municipality. According to the U.S. Bureau of the Census figures, the population in 1970 for this municipality was 19,416 (Reference 3).

The climate within the study area is characterized by warm, wet summers and warm, but dry, winters. Daily average temperatures at Mayaguez are 26.2°C in the summer and 24.2°C in the winter. The rainfall distribution varies over the watershed. The long-term average annual rainfall for a 52-year period of record at Mayaguez is 202 centimeters. Weighted average annual rainfall for the watershed is 236 centimeters. The wet season usually occurs from April through November and the dry season from December through March (Reference 4).

2.3 Principal Flood Problems

Most floods in the Rio Grande de Anasco Basin are produced by high-intensity rainfall, usually in the upper reaches of the watershed, and generally in conjunction with tropical disturbances or storms in the mountains.

Flood problems in the study area are serious and widespread. Periodic floodwater damage to sugarcane, pastureland, roads, and a number of residential areas is significant. Floodwaters have inundated the main Rio Grande de Anasco flood plain 17 times in the last 31 years, an average of approximately once every 2 years.

According to the U.S. Geological Survey Hydrologic Investigation Atlas for the area (Reference 5), the flood plain of lower Rio Grande de Anasco has been inundated extensively at least six times during the period 1899-1975. The greatest known flood occurred in September 1975. The second greatest flood was that of September 1928. Other major floods occurred in September 1932, September 1952, October 1970, and August 1899. The U.S. Geological Survey estimated the peak flow for the September 1975 flood to be 3965 cubic meters per second (cms). This is based on a preliminary flood map and investigation recently conducted by the U.S. Geological Survey (Reference 6). It is estimated that the recurrence interval for this flow is approximately 100 years, based on the Regional

Analysis incorporating Rio Grande de Anasco gage records (Reference 7). The U.S. Geological Survey estimated the peak flow for the September 1928 flood at El Espino to be 992 cms (Reference 5). It is estimated that the recurrence interval for this flow is approximately 7 years, based on the Regional Analysis incorporating the Rio Grande de Anasco gage records (Reference 7).

2.4 Flood Protection Measures

At present, there are no flood protection measures for the Rio Grande de Anasco Basin. There is only one proposed flood protection project in the study area, sponsored jointly by the Commonwealth of Puerto Rico Department of Natural Resources, the Commonwealth of Puerto Rico Department of Agriculture, and the Soil Conservation Districts of the southwest area of Puerto Rico. The project was designed by the U.S. Soil Conservation Service and consists of four floodwater retarding structures, eight debris basins located in the northwest portion of the basin along Puerto Rico Highway 402, and 30.14 kilometers of channel works (Reference 1). Of those measures, only one floodwater retarding structure has the funds assigned, and is expected to be finished in 2 years. This retarding structure was designed to store the runoff from a 100-year frequency event. The upstream drainage area that will be affected by it is approximately 1.4 square kilometers; however, since this drainage area is a negligible portion of the entire drainage area of the watershed, the structure will not affect the discharges used in this report.

It is noted that a new bridge is being planned for Puerto Rico Highway 2 over Rio Grande de Anasco. As of December 1979, its design was still in development. According to the Commonwealth of Puerto Rico Department of Transportation and Public Works, it is estimated that this bridge will not be completed until early 1982. Hydraulic analysis was based on the present bridge structure.

Development of flood plain areas in Puerto Rico is controlled by Puerto Rico Planning Board Regulation No. 13 and amendments (References 8 and 9).

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the basin, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance,

respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual occurrence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported here reflect flooding potentials based on conditions existing in the basin at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail in the basin.

Discharge-frequency relationships for Rio Grande de Anasco were based on statistical analyses of discharge records from 1963 to 1976 at the Anasco gaging station No. 501440 operated by the U.S. Geological Survey (Reference 10). These analyses followed the standard log-Pearson Type III method as outlined by the U.S. Water Resources Council (Reference 11). Because of the short period of record, the statistical analyses were modified by combining the above data with the Regional Analysis, as presented in Water Resources Investigation 1978 prepared by the U.S. Geological Survey in cooperation with the Commonwealth of Puerto Rico (Reference 12). The regional analysis is based on statistical computations of discharge records at 37 sites in Puerto Rico, with 10 or more years of record, regressed against basin characteristics. Drainage area and mean annual rainfall proved to be the only independent variables at the 95-percent confidence level. The 500-year discharge values were extrapolated from the lower frequency floods.

Peak discharge-drainage area relationships for Rio Grande de Anasco are shown in Table 1.

The storm tide height-frequency analysis was taken from a report prepared by the National Oceanic and Atmospheric Administration for the Federal Emergency Management Agency (Reference 13). In this report, storm tide height-frequency distributions on the coast of Puerto Rico were developed by computing storm tides from a full set of climatologically representative hurricanes, using the National Weather Service hydrodynamic storm-surge model (Reference 14) adapted to local conditions. Hurricane parameters needed for the storm-tide computations were analyzed as presented in this study.

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Table 1. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Kilometers)	Peak Discharges (Cubic Meters per Second) 10-Year	50-Year	100-Year	500-Year
Rio Grande de Anasco					
At Mouth	525.4	1894	4061	5227	7249
Downstream of Confluence With Rio Daguey	488.1	1784	3820	4916	7051
Upstream of Confluence With Rio Daguey	472.3	1761	3749	4814	6853
Downstream of Confluence With Rio Canas	463.7	1736	3693	4740	6717
Upstream of Confluence With Rio Canas	426.7	1645	3475	4451	6400
Downstream of Confluence With Rio Casey	415.5	1611	3398	4354	6173
Upstream of Confluence With Rio Casey	389.6	1552	3251	4151	5918
400 Meters Upstream of Puerto Rico Highway 406	381.1	1524	3191	4078	5720

The 50-year elevations for the Atlantic Ocean were interpolated from the graph for the 10-, 25-, 100-, and 500-year recurrence intervals (Reference 13).

Elevations for floods of the selected recurrence intervals on the Atlantic Ocean at the Rio Grande de Anasco Basin are shown in Table 2.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding sources studied in the basin were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of these flooding sources.

Water-surface elevations of floods of the selected recurrence intervals for Rio Grande de Anasco were computed through use of the U.S. Army Corps of Engineers HEC-2 step-backwater computer program (Reference 15).

Cross sections for the backwater analyses were obtained from aerial photographs flown in November 1978, at a scale of 1:5000 (Reference 16). The below-water sections were obtained by field measurement. All bridges, dams, and culverts were field checked to obtain elevation data and structural geometry (Reference 17).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the streams and flood plain areas. Roughness values for the main channel of Rio Grande de Anasco ranged from 0.04 to 0.06, and flood plain roughness values ranged from 0.07 to 0.19 for all floods. The acceptability of all assumed hydraulic factors, cross sections, and hydraulic structure data was checked by computations that duplicated historic floodwater profiles contained in the U.S. Geological Survey Hydrologic Investigation Atlas for the area (Reference 5). Computations were also made which duplicated high water marks from the September 1975 flood, in order to determine roughness values (Reference 6).

Starting water-surface elevations for Rio Grande de Anasco were based on the 1-year storm tide. Elevations of the 1-year storm tide and the 10-year storm tide are approximately equal.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.15 meter for floods of the selected recurrence intervals (Exhibit 1).

Table 2. Summary of Elevations

Flooding Source and Location	Elevation (Meters) 10-Year	50-Year	100-Year	500-Year
Atlantic Ocean (Mona Passage) At Mouth of Rio Grande de Anasco	0.6	1.4	1.6	2.7

Information regarding tidal frequencies at the Atlantic coast was obtained from a report by the National Oceanic and Atmospheric Administration (Reference 13). It was found that flooding at the coast from inland riverine sources was much more significant than tidal flooding. That is, riverine flooding controls all the way to the coastline. This is largely due to the relatively high elevation of the coastal flood plain. Accordingly, no inland routing of tides was conducted.

Water-surface elevations for Rio Daguey were based on normal-depth calculations.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are, thus, considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to Mean Sea Level (MSL). Elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the Federal Emergency Management Agency as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:5000, with a contour interval of 1 meter (Reference 16).

Tidal boundaries were delineated using topographic maps at a scale of 1:20,000, with a contour interval of 10 meters, supplemented with contour intervals of 1 meter (Reference 18).

The flood boundaries on Rio Daguey were developed from normal-depth calculations and topographic maps at a scale of 1:5000, with a contour interval of 1 meter (Reference 16).

Approximate flood boundaries in some portions of the study area were taken from the Federal Emergency Management Agency Flood Insurance Rate Map (Reference 19).

Flood boundaries for the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood boundaries are close together, only the 100-year flood boundary has been shown. Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to limitations of the map scale and/or lack of detailed topographic data, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of the Federal Emergency Management Agency limit such increases in flood heights to 0.30 meter, provided that hazardous velocities are not produced. The floodways in this report are presented to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

The floodways presented in this study were computed on the basis of equal-conveyance reduction from each side of the flood plain. The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 3).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 0.30 meter at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (METERS)	SECTION AREA (SQUARE METERS)	MEAN VELOCITY (METERS PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(METERS MSL)			
Rio Grande de Anasco								
A	109	4,728	4,709	1.1	2.48	2.48	2.78	0.30
B	602	4,831	7,982	2.7	3.43	3.43	3.53	0.10
C	1,041	5,186	10,016	0.5	3.63	3.63	3.76	0.13
D	1,408	5,434	12,721	0.4	3.76	3.76	3.90	0.14
E	1,778	5,714	13,478	0.4	3.91	3.91	4.06	0.15
F	2,160	5,741	14,460	0.4	4.36	4.36	4.52	0.16
G	2,446	5,545	14,893	0.4	4.66	4.66	4.82	0.16
H	3,077	4,615	16,249	0.3	5.45	5.45	5.62	0.17
I	3,277	3,562	9,005	0.5	5.98	5.98	6.16	0.18
J	3,885	2,793	5,911	0.8	6.70	6.70	6.83	0.13
K	4,768	1,935[2]	4,718	1.0	7.23	7.23	7.32	0.09
L	6,141	1,978[2]	4,804	1.0	8.05	8.05	8.15	0.10
M	7,107	2,429	6,703	0.7	8.61	8.61	8.68	0.07
N	9,007	2,219	6,663	0.7	8.97	8.97	9.05	0.08
O	9,878	2,130	6,442	0.7	9.37	9.37	9.45	0.08
P	10,895	1,781	5,364	0.8	10.16	10.16	10.28	0.12
Q	11,240	1,401	5,221	0.9	10.88	10.88	11.02	0.14
R	12,285	612	3,958	1.1	12.12	12.12	12.21	0.09
S	12,690	532	2,920	1.5	12.59	12.59	12.75	0.16
T	13,653	622	4,383	1.0	14.17	14.17	14.33	0.16
U	14,562	451	2,484	1.7	14.69	14.69	14.94	0.25
V	14,892	420	2,409	1.7	15.20	15.20	15.42	0.22
W	15,119	405	2,226	1.9	15.55	15.55	15.77	0.22
X	15,374	323	1,744	2.3	16.08	16.08	16.36	0.28
Y	15,665	537	2,630	1.6	17.06	17.06	17.26	0.20

[1]Meters Above Mouth [2]Width Does Not Include Island

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE DE ANASCO, PR

FLOODWAY DATA

RIO GRANDE DE ANASCO

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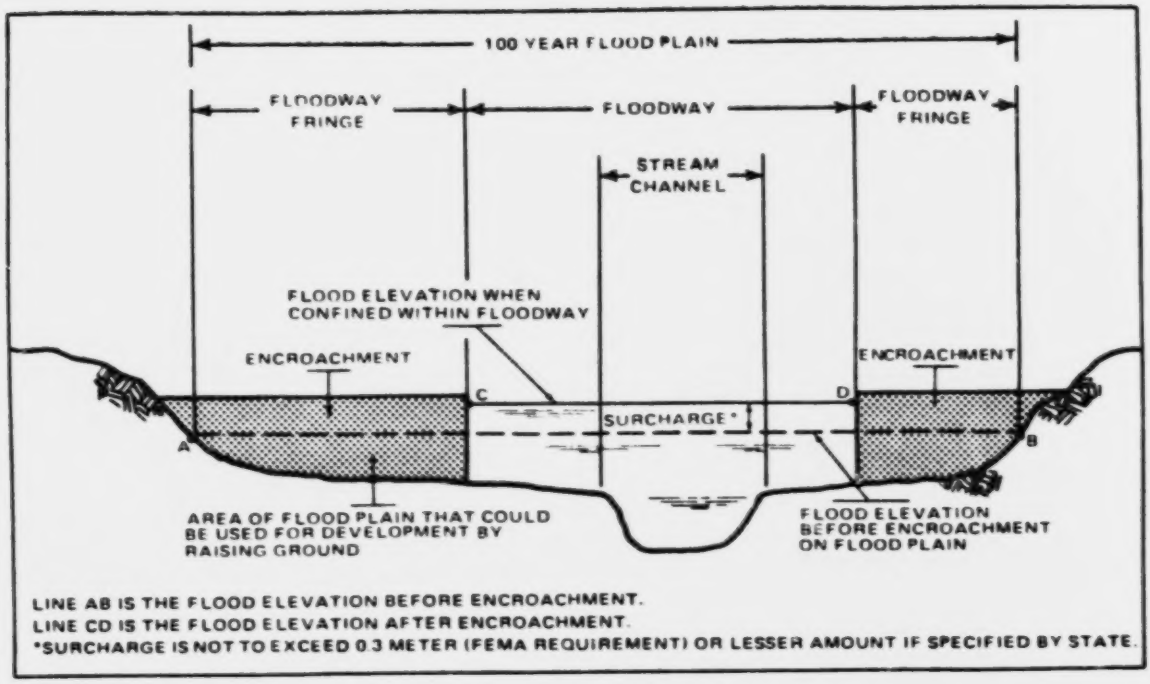
100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 0.3 METER (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

Figure 2. Floodway Schematic

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the Federal Emergency Management Agency has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for each flooding source studied in detail affecting Rio Grande de Anasco Basin.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 0.61 meter	0.15 meter
0.61 to 2.13 meters	0.30 meter
2.13 to 3.66 meters	0.61 meter
More than 3.66 meters	0.91 meter

The locations of the reaches determined for the flooding sources of Rio Grande de Anasco Basin are shown on the Flood Profiles (Exhibit 1) and summarized in Table 4.

5.2 Flood Hazard Factors

The FHF is the Federal Emergency Management Agency device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHF are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.15 meter, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.21 meter, the FHF is 005; if the difference is 0.43 meter, the FHF is 015; if the difference is 1.52 meters, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 3.05 meters, accuracy for the FHF is to the nearest 0.30 meter.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the Rio Grande de Anasco Basin was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zone V7:	Special Flood Hazards along coast inundated by the 100-year flood, as determined by detailed methods, and that have additional hazards due to velocity (wave action); base flood elevations shown, and zones subdivided according to FHFs.
Zones A7, A8, and A17:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood, including areas of the 500-year

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (METERS MSL)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Rio Grande de Anasco							
Reach 1	0070,0132	-1.18	-0.34	0.54	040	A8	Varies - See Map
Reach 2	0070,0075	-2.53	-0.75	1.23	085	A17	Varies - See Map
Atlantic Ocean							
Reach 1	0070,0132	-1.00	-0.20	1.10	035	V7,A7	1.6

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest 0.1 Meter

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE DE ANASCO, PR

FLOOD INSURANCE ZONE DATA

RIO GRANDE DE ANASCO-ATLANTIC OCEAN

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flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also areas subject to certain types of 100-year shallow flooding where depths are less than 0.30 meter; and areas subject to 100-year flooding from sources with drainage areas less than 2.60 square kilometers. Zone B is not subdivided.

Zone C: Areas of minimal flooding.

The flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are summarized in Table 4.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for Rio Grande de Anasco Basin is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected 0.1-meter water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the Federal Emergency Management Agency.

6.0 OTHER STUDIES

A Flood Insurance Study is currently being conducted for the Rio Culebrinas Basin, located adjacent to the Rio Grande de Anasco Basin (Reference 20). The results of this study will be compatible with that of the aforementioned study.

The National Oceanic and Atmospheric Administration produced a report entitled Storm Tide Frequency Analysis for the Coast of Puerto Rico in 1975 (Reference 13). Tidal elevations shown in this Flood Insurance Study were obtained from that report.

The Federal Emergency Management Agency has previously published a Flood Insurance Rate Map for the Rio Grande de Anasco Basin as a part of the Commonwealth of Puerto Rico Flood Insurance Study (Reference 19). Data presented in this report represent a more detailed analysis.

This study is authoritative for the purposes of the National Flood Insurance Program; data presented herein either supersede or are compatible with all previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, 26 Federal Plaza, Room 19-100, New York, New York 10278.

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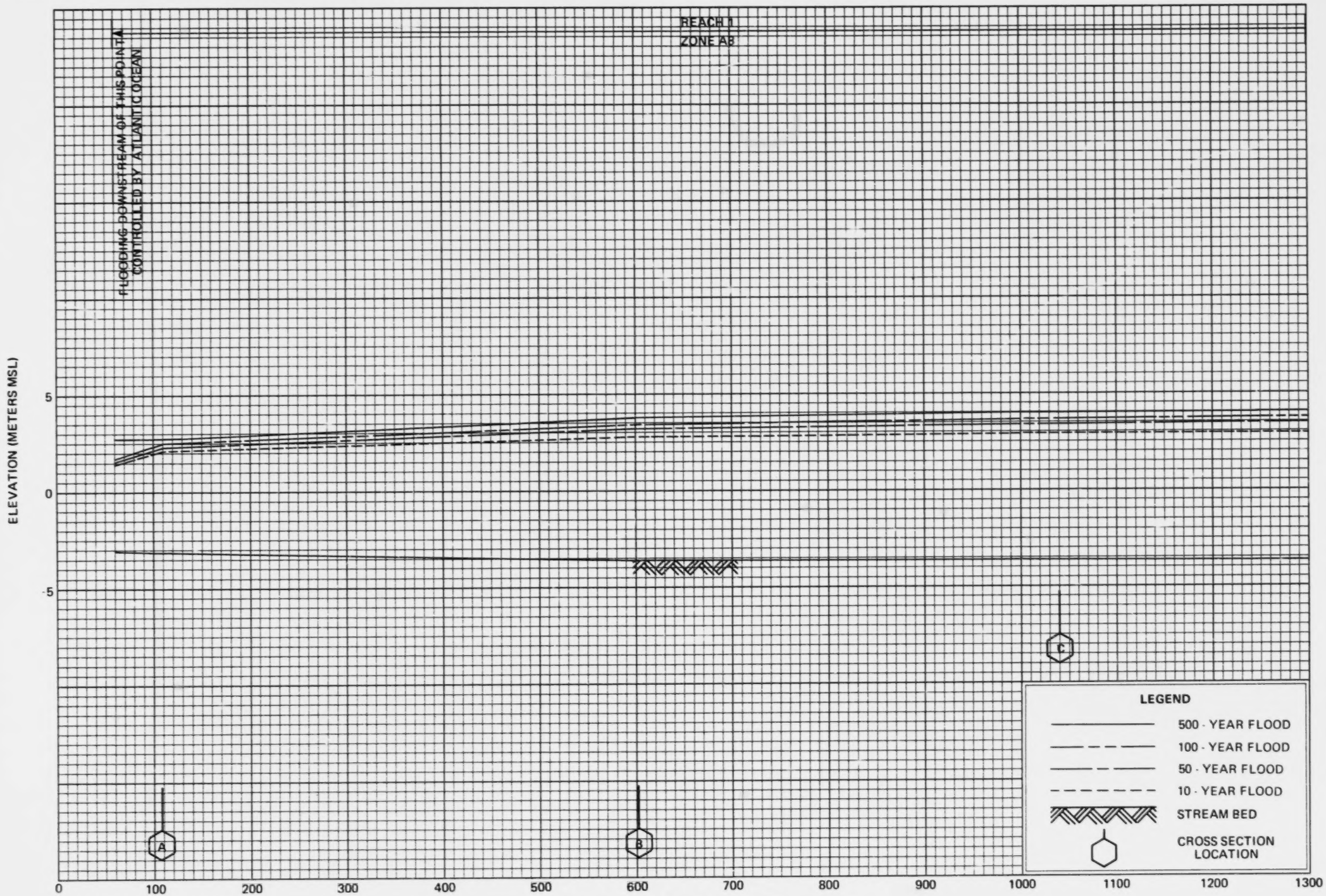

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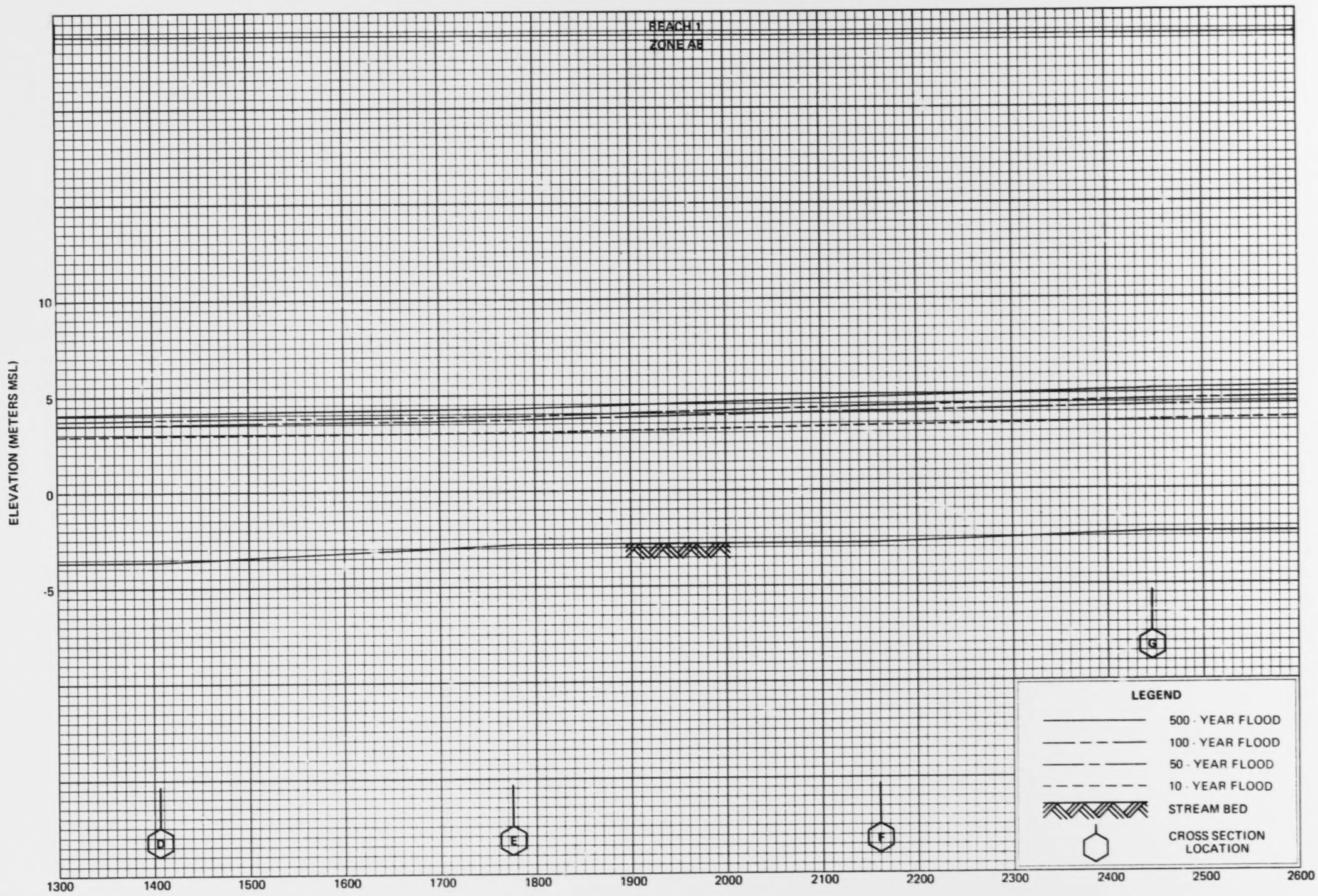

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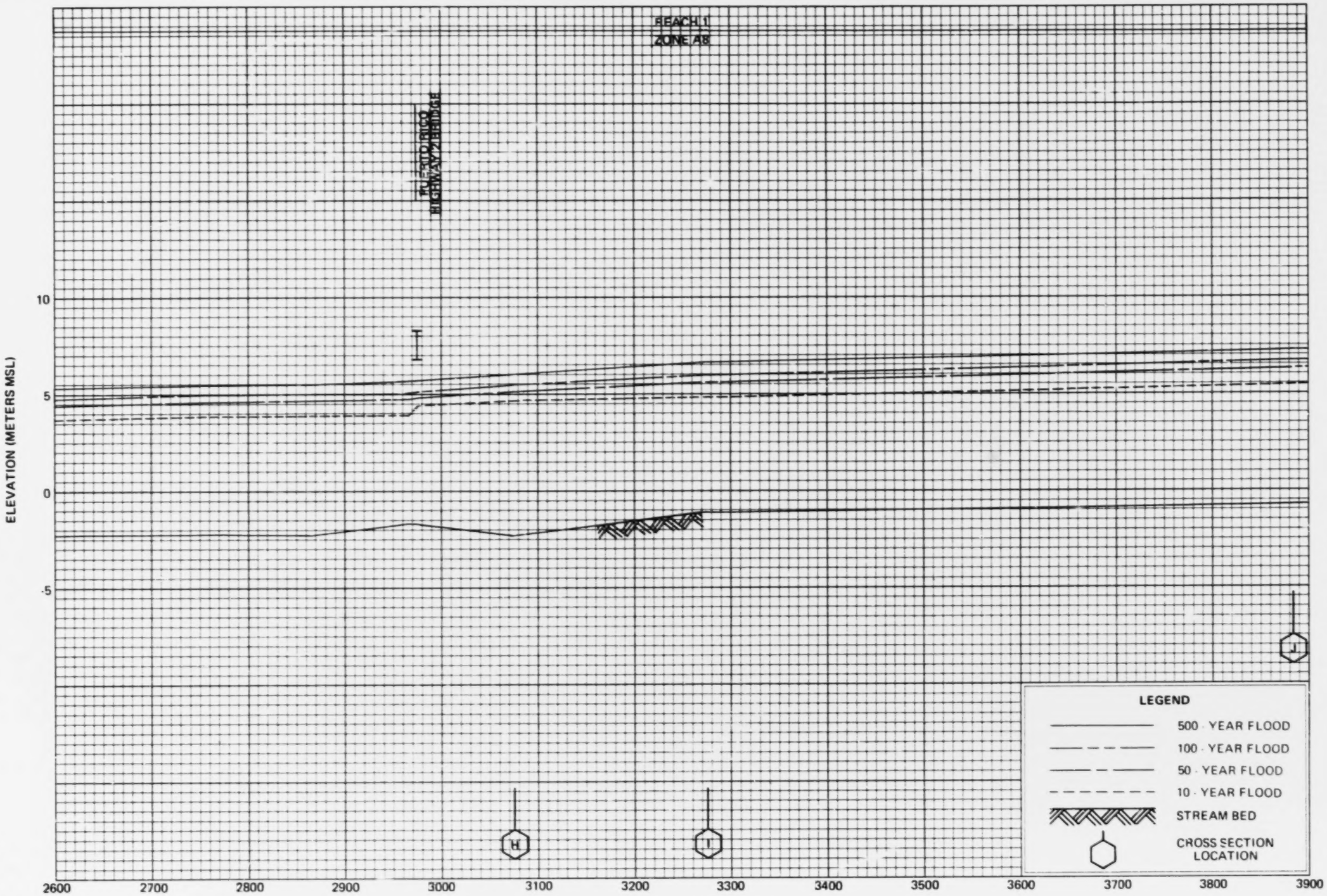

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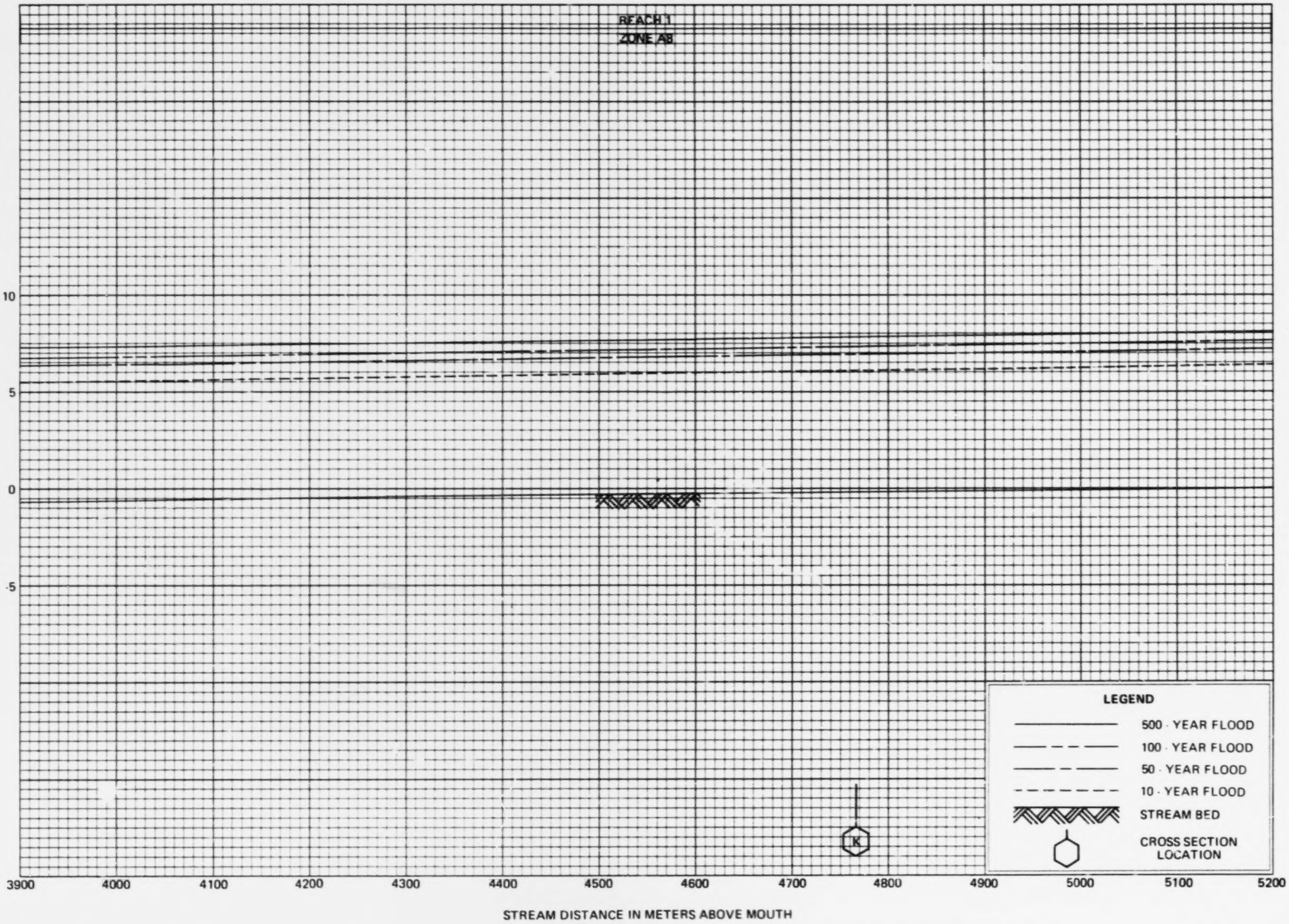

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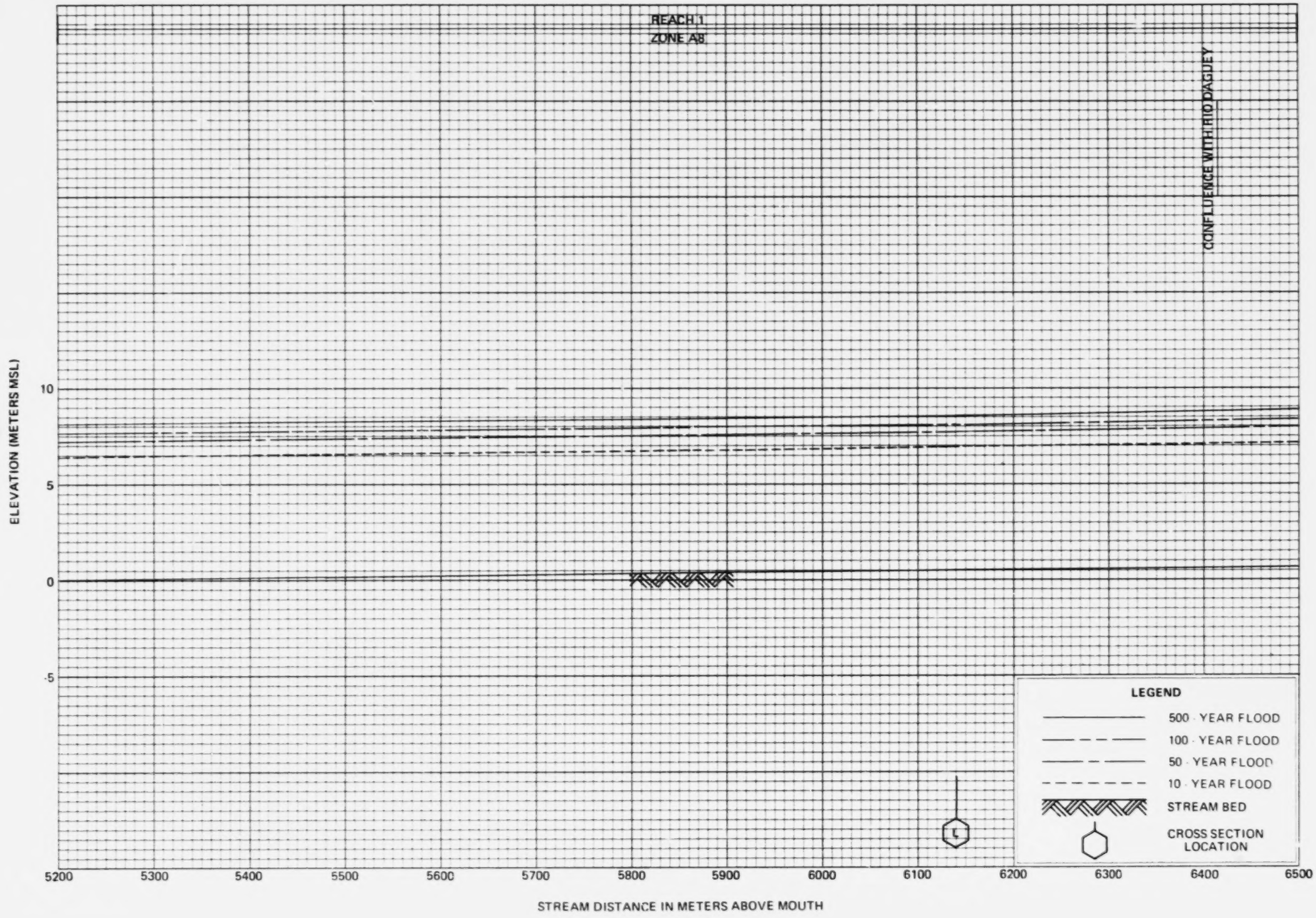

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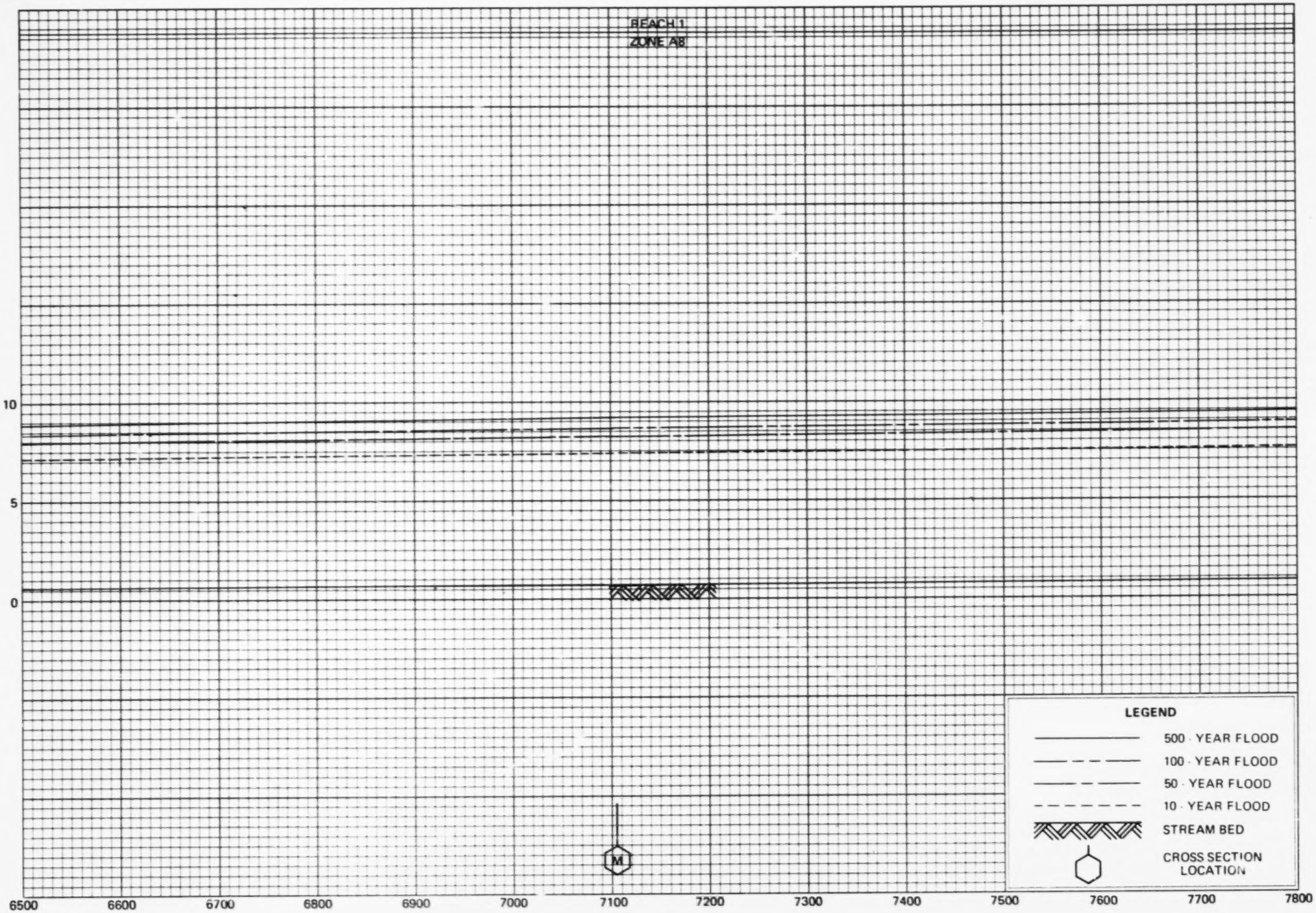

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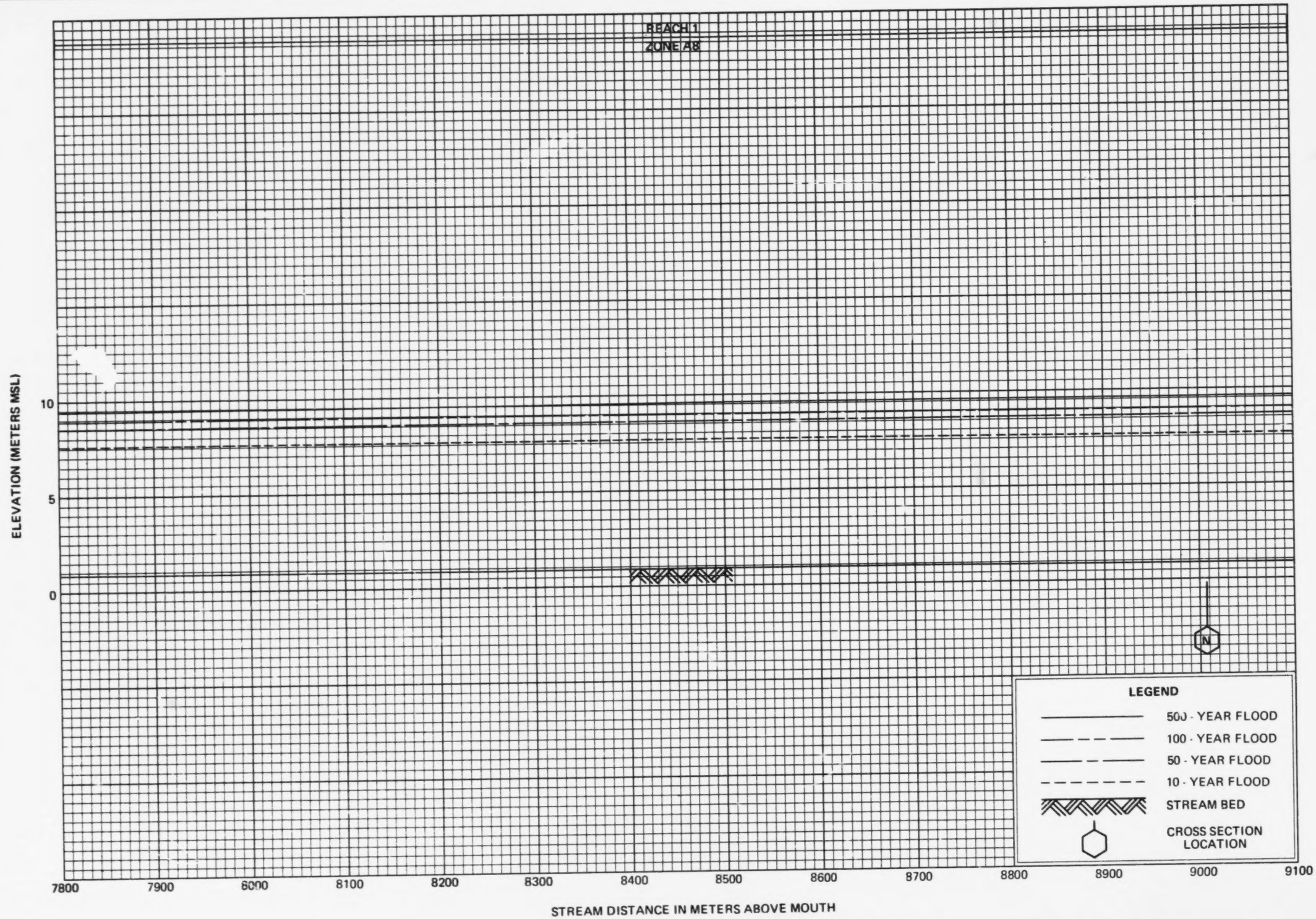

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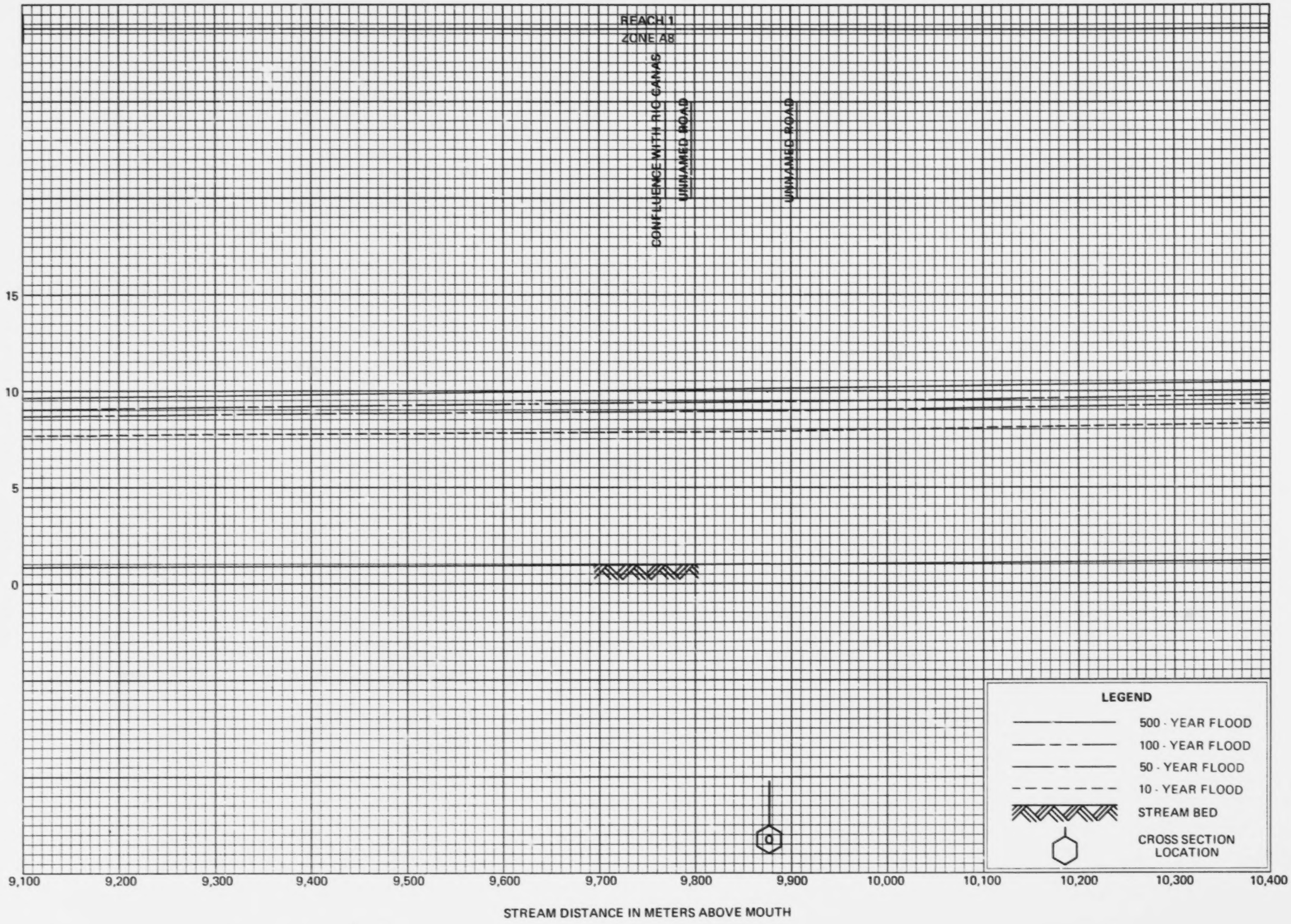

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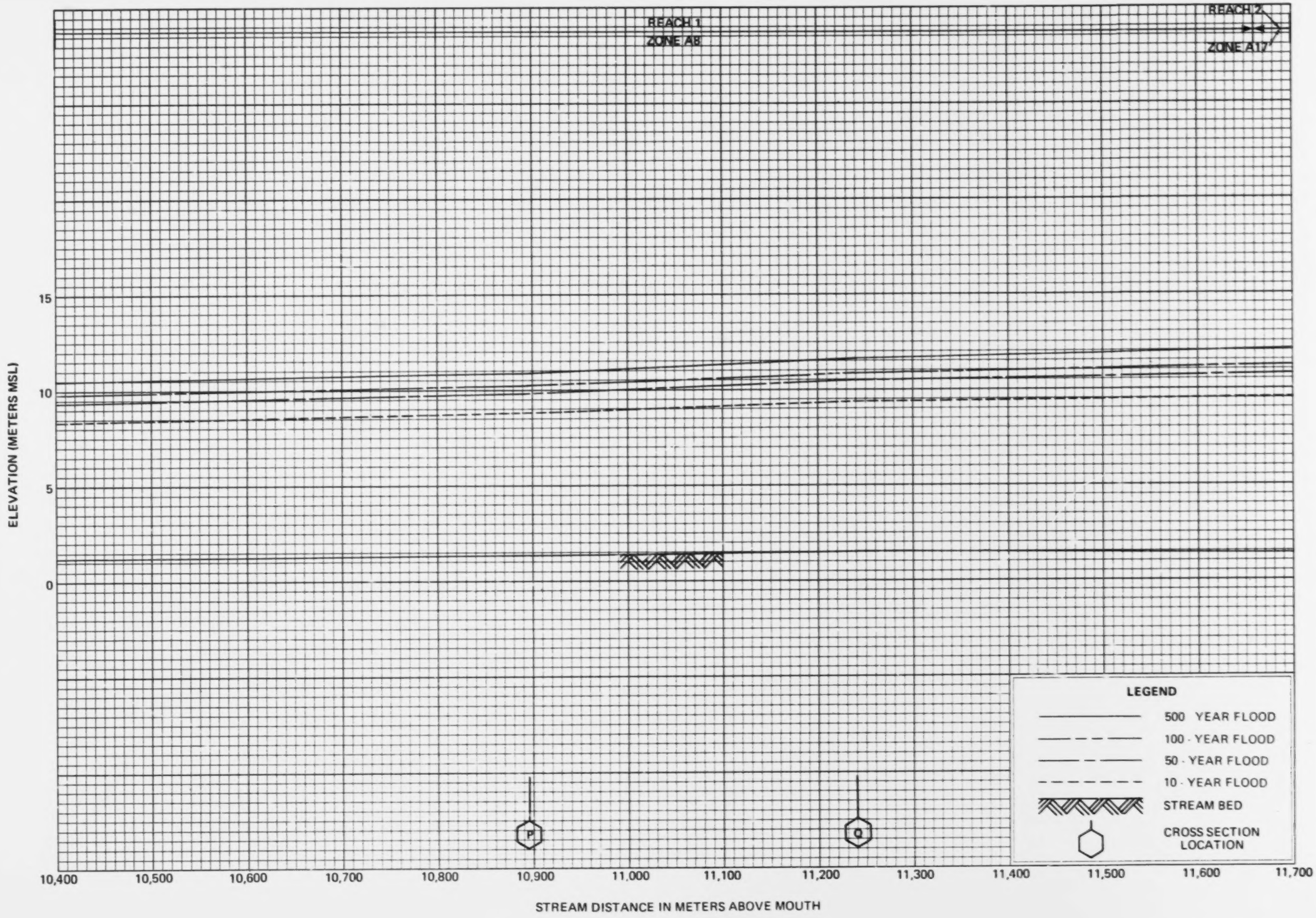

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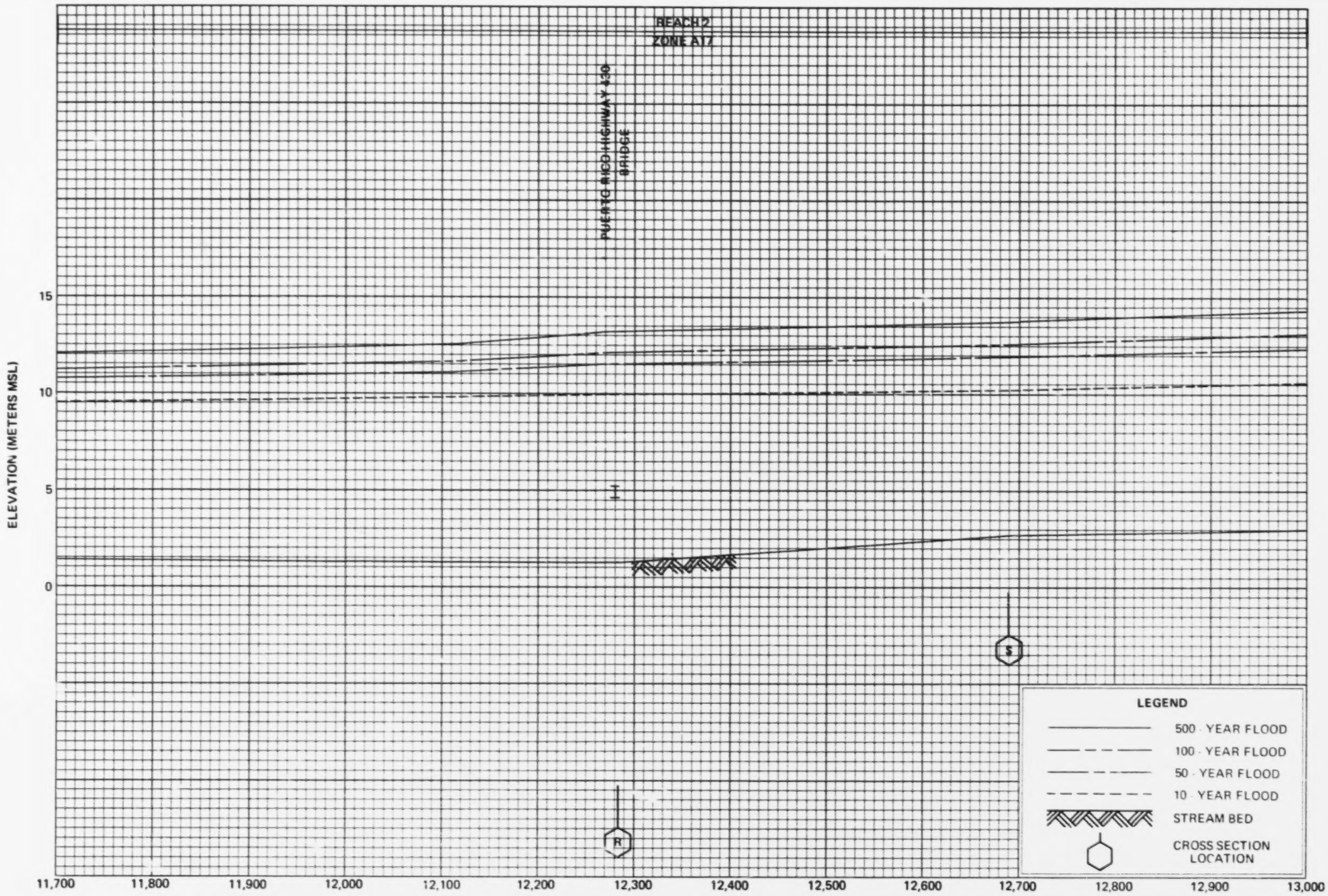

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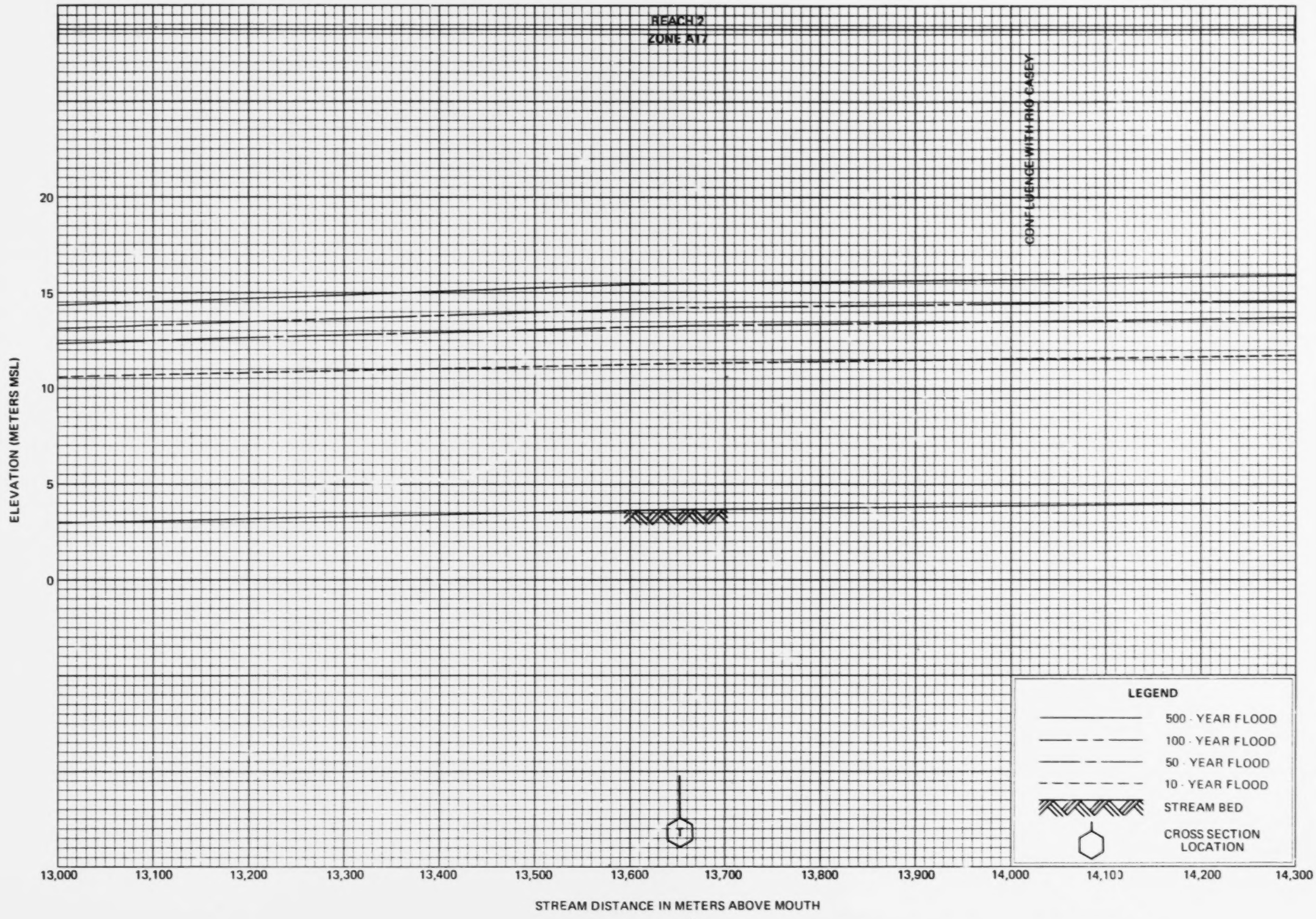

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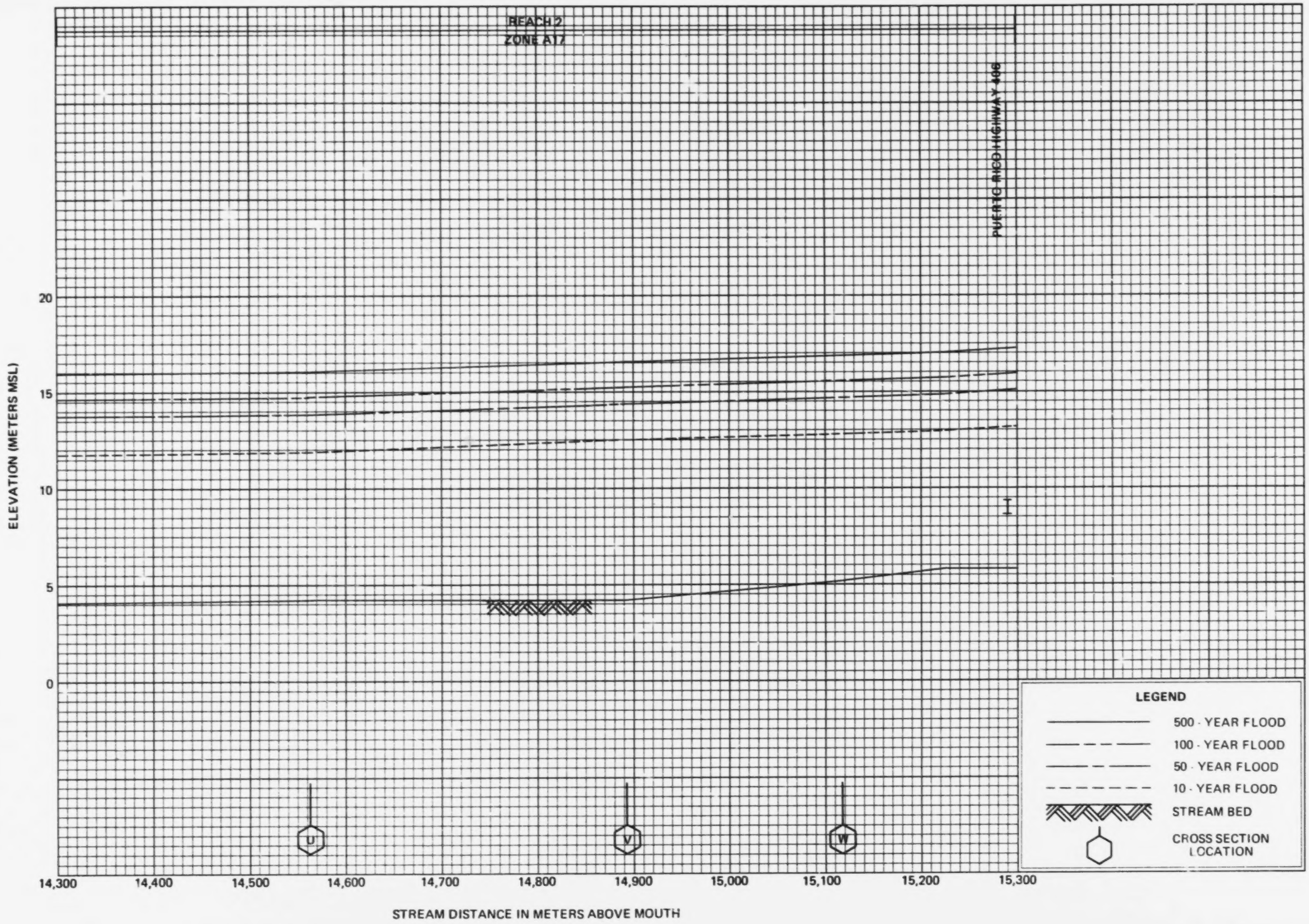

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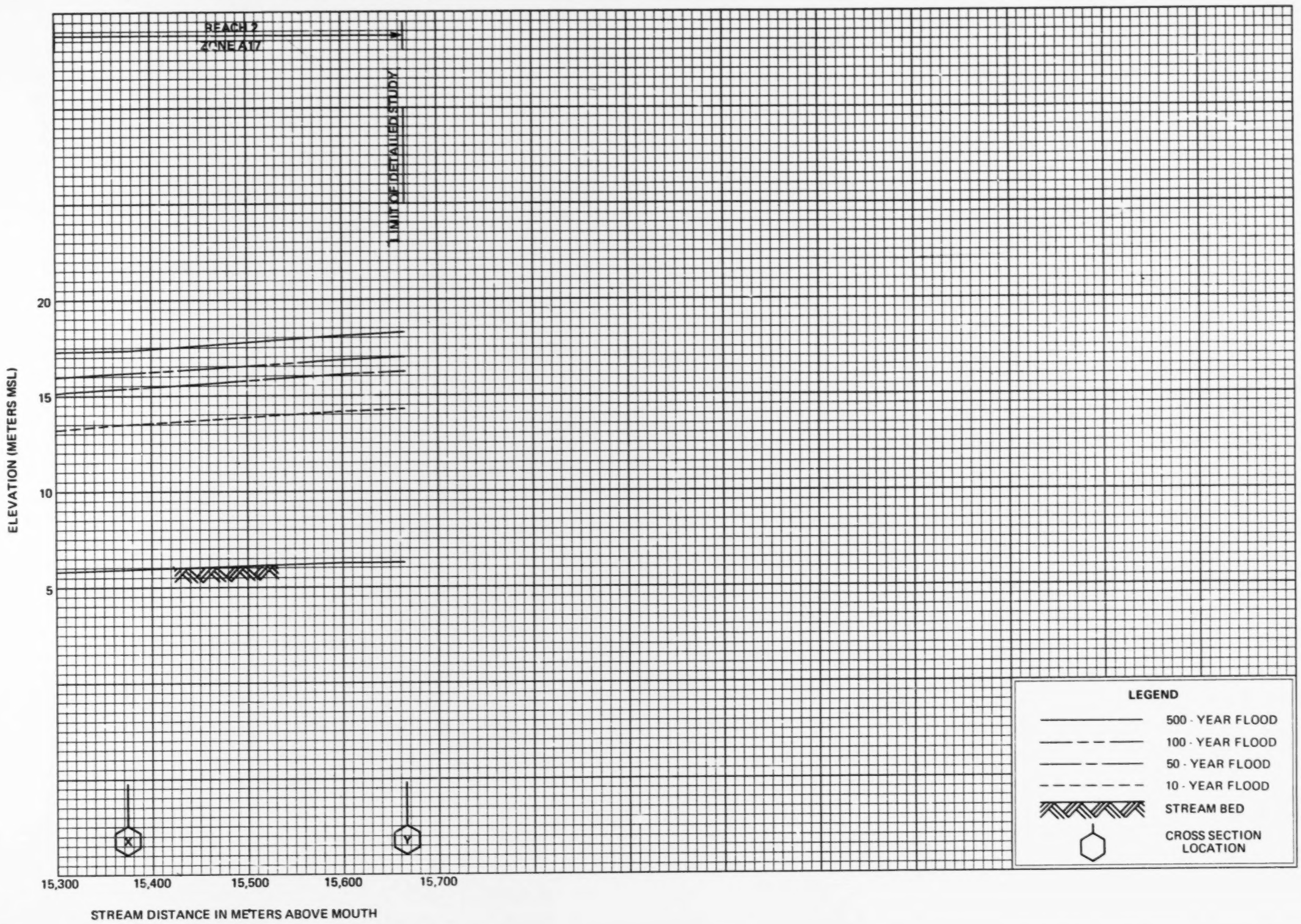

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